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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Radiation tolerance of the PNI RM3100 magnetometer for a Europa lander mission" *by* Leonardo H. Regoli et al.

Anonymous Referee #1

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Summary: The authors present the results of two radiation test campaigns for PNI RM3100 magnetometers based on expected conditions for a Europa lander. Instruments were tested to a notional Total Integrated Dose (TID) of 300 krad at two facilities with some sensors being tested while active and others tested while unpowered. The results of these tests varied with some sensors continuing to function, some showing intermittent failures, and one failing completely.

Major Comments:

The authors should expand on the potential implications of placing a magnetometer inside a radiation vault with other instruments. In many applications it is necessary to separate the sensor from the supporting electronics and the spacecraft/lander to mitigate stray magnetic fields. Can useful scientific magnetic field measurements be

made from within a radiation vault co-located with other instruments or would it be necessary to place the sensing element itself outside (the electronics could conceivably stay in the vault) thus dramatically increasing the expected dose experienced by the sensor?

The authors have not established metrics against which to assess the magnetometer performance. Rather, the analysis is primarily verifying gross function (the continuing measurement of a magnetic field rather than a complete loss of signal). The authors are assessing functional rather than parametric failure. It would be appropriate to have some context of notional measurement/instrument requirements for a Europa Lander mission (noise, range, sensitivity, stability, etc.) to evaluate the utility of the magnetometer's performance after irradiation.

Can the authors quantify the impact of irradiation on the sensitivity and/or baseline stability of the magnetometer? The results for Sensor 9 in Figure 8 suggest a gain and/or offset error of $\sim$3% after irradiation which seems very high by magnetometer standards – particularly in a Jovian application where presumably in-situ calibration may be challenging as the main field is not well understood.

Can you quantify the impact of irradiation on the noise performance of the instrument beyond what appear to be standard deviation ("std:")? For example, average spectral transforms of the data of pre and post irradiation date (Figure 9) would be useful to assess the noise floor and determine the standard pT/sqrt(Hz) at 1 Hz figure of merit.

Minor Comments:

Line 49: Is the dosage accumulated during transit from Earth to Europa significant compared to the dosage accumulated on the surface? Is the transit dosage included in these estimates?

Figure 1: Could the authors speculate on what portion of the magneto-inductive instrument is primarily susceptible to TID?

Line 81: Is there any concerns about Enhanced Low Dose Rate Sensitivity (ELDRS)?

Figure 7: Can the intermittent failures shown for Sensor 5 be corrected by power cycling? i.e., are this single event upsets/latchups or TID failures?

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